



PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 09/994,004
Filing Date: 11/16/01
Applicants: Deeney et al.
Group Art Unit: 2827
Examiner: Jeremy Norris
Title: Method and Apparatus for Supporting a Circuit
Component Having Solder Column Interconnects
Using an External Support
Attorney Docket: 10015590-1

Commissioner of Patents and Trademarks
Washington, D.C. 20231

AMENDMENT

Sir:

In response to the Office Action mailed October 4, 2002, please amend the application as follows and consider the remarks set forth below.

IN THE SPECIFICATION

Please amend the title on the cover page of the application as set forth below. Applicants include herewith an Attachment for Specification Amendments showing a marked up version of the title.

METHOD AND APPARATUS FOR SUPPORTING A CIRCUIT COMPONENT
HAVING SOLDER COLUMN INTERCONNECTS USING AN EXTERNAL
SUPPORT.

IN THE CLAIMS

Please amend claims 2 – 13, 15 and 16 in accordance with the following rewritten claims in clean form. Applicants include herewith an Attachment for Claim Amendments showing a marked up version of each amended claim.

1. (Amended) A circuit board assembly, comprising:
 - a. a circuit board;
 - b. an integrated circuit package having a substrate with an array of solder columns extending from a bottom surface of the substrate to the circuit board when the integrated circuit package is mounted on the circuit board; and
 - c. at least one support member affixed to at least one of a side of the substrate and a top surface of the substrate when the integrated circuit package is mounted to the circuit board, the at least one support member extending to the circuit board.

2. (Amended) The circuit board assembly of claim 1 wherein the support member is affixed to the integrated circuit package by adhesive after the integrated circuit package is mounted to the circuit board the adhesive accommodating any variation in height of the integrated circuit package.

3. (Twice Amended) The circuit board assembly of claim 2 wherein the integrated circuit package has a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate, each support member having a flange extending over the upper surface of the substrate, the flange of each support member affixed to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

4. (Amended) The circuit board assembly of claim 3 wherein the support member comprises a frame surrounding the integrated circuit package.

5. (Twice Amended) The circuit board assembly of claim 4 wherein the frame is rectangular and has a support leg and an inwardly extending flange at each corner, each support leg having first and second segments approximately at right angles to each other and each flange having first and second segments at approximately right angles to each other, each flange secured to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

6. (Twice Amended) The circuit board assembly of claim 5 wherein the flanges are secured to both the outer perimeter of the package lid and the upper surface of the substrate by adhesive.

7. (Amended) The circuit board assembly of claim 3 wherein the integrated circuit package is a column grid array integrated circuit package.

8. (Twice Amended) The circuit board assembly of claim 2 wherein the support member comprises a frame surrounding the integrated circuit package with an inner side of the frame affixed by adhesive to at least one of an outer side of the substrate and an outer perimeter of a lid affixed to the substrate, the adhesive accommodating any variation in height of the integrated circuit package.

9. (Amended) The circuit board assembly of claim 2 wherein the support member comprises a support leg.

10. (Twice Amended) The circuit board assembly of claim 9, wherein the integrated circuit package has a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate, each support leg having a flange extending over an upper surface of the substrate, each flange affixed to at least one of an outer perimeter of the lid and the upper surface of the substrate by adhesive, the adhesive accommodating any variation in height of the integrated circuit package.

11. (Amended) The circuit board assembly of claim 9 wherein the integrated circuit package is rectangular and has a support leg at each corner.

12. (Twice Amended) The circuit board assembly of claim 11, wherein each support leg is affixed to at least one of an outer perimeter of a lid affixed to the substrate and an outer perimeter of the substrate by adhesive, the adhesive accommodating any variation in height of the integrated circuit package.

13. (Twice Amended) The circuit board assembly of claim 10 wherein the integrated circuit package is a column grid array integrated circuit package.

14. (Twice Amended) A circuit board assembly, comprising:

- a. a circuit board;
- b. a column grid array integrated circuit package having a substrate with an array of solder columns extending from a bottom surface of the substrate to the circuit board when the column grid array integrated circuit package is mounted on the circuit board, the column grid array integrated circuit package having a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate; and
- c. at least one support member affixed to at least one of an outer perimeter of the lid and a top surface of the substrate by adhesive after the column grid array integrated circuit package has been mounted to the circuit board, the adhesive accommodating any variation in height of the column grid array integrated circuit package, the at least one support member extending to the circuit board.

15. (Twice Amended) The circuit board assembly of claim 14, wherein each support member has a flange extending over the upper surface of the substrate, the flange of each support member affixed to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

16. (Twice Amended) The circuit board assembly of claim 15 wherein the column grid array integrated circuit package is rectangular and the support member comprises a rectangular frame extending around the substrate, the frame having a support leg and an inwardly extending flange at each corner, each support leg having first and second segments approximately at right angles to each other and each flange having first and second segments at approximately right angles to each other, each flange secured to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

REMARKS

Applicants thank the Examiner for the indication that claims 4 – 6, 8, 16 and 19 contain allowable subject matter.

Claims 1 – 21 are now pending in the application. Minor amendments have been made to certain claims to clarify them. The amendments to these claims contained herein are of equivalent scope as originally filed and, thus, are not a narrowing amendment.

Applicants have amended the title on the cover page of the application to conform it to the title on the first page of the application by deleting a typographical error.

REJECTION UNDER 35 U.S.C. § 112

Claims 2 – 13, 15 and 16 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point and distinctly claim the subject matter which Applicants regard as the invention. This rejection is respectfully traversed.

These claims are all dependent claims, depending directly or indirectly from one of independent claims 1 and 14. Since independent claims 1 and 14 begin by reciting “[a] circuit board assembly,” the Examiner has taken the position that these dependent claims are indefinite under § 112, second paragraph, because they begin with “[t]he apparatus” as opposed to “[t]he circuit board assembly.”

Claims are commonly referred to as either apparatus claims or method claims. In this case, claims 1 and 14 are apparatus claims because they are directed to an apparatus as opposed to a method. Applicants submit that it is fairly common to begin a dependent claim that depends from an apparatus claim with

“[t]he apparatus of claim ____” and that doing so satisfies § 112, second paragraph. Further, at best, this is a clerical issue that is more properly an objection under § 112, second paragraph as opposed to a substantive rejection. Nevertheless, to further prosecution, Applicants have amended the preamble’s of each of these dependent claims so that they now begin with the recitation of “[t]he circuit board assembly.”

REJECTION UNDER 35 U.S.C. § 102

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Bivona (U.S. Pat. No. 5,990,418). This rejection is respectfully traversed.

Bivona is directed to a device and method for hermetically sealing an integrated circuit chip between a substrate and a lid. As discussed below, it’s standoff 602 supports the lid of the integrated circuit package with respect to the substrate of the integrated circuited package. It is not directed to supporting a circuit package on a circuit board.

Referring to Fig. 6 of Bivona, the Examiner takes the position that Bivona discloses “an integrated circuit package having a substrate (100) with an array of solder columns 112, (see figure 1 and col. 5, lines 20 – 35) extending from a bottom surface of the substrate to the circuit board when the integrated circuit package is mounted on the circuit board; and at least one support member (602) affixed to at least one side of the substrate and a top surface of the substrate when the integrated circuit package is mounted to the circuit board.” Bivona’s member 602 is a standoff mounted within an integrated circuit package. As described in Bivona, “[i]n Fig. 6, shortened standoff 602 is bonded to carrier substrate 100 by bond 604, such as epoxy. Shortened standoff 602 does not contact the underside of lid 104 and allows

lid 104 to deflected toward integrated circuit chip 102 before shortened standoff 602 comes into contact with lid 104. In this way, a small amount of play may be built into lid 104 to prevent excessive downward forces on carrier substrate 100 thereby preventing mechanical stress on carrier substrate 100.” [Bivona, col. 6, lines 42 – 50]

Applicants’ invention is directed to supporting a circuit package on a circuit board, the circuit package having a substrate with an array of solder columns extending from a bottom surface of the substrate to the circuit board. Applicants have amended claim 1 to make this clear. As amended, claim 1 recites, in pertinent part, the at least one support member “extending to the circuit board.” As amended, Applicants submit that claim 1 is allowable over Bivona.

Claims 1 – 3, 9, 10, 17, 18 and 20 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Lin et al. (U.S. 5,239,198). This rejection is respectfully traversed.

Claim 1 is directed to supporting an integrated circuit package having a substrate with an array of solder columns on a circuit board. Solder columns, as described in the application on page 1, are sufficiently tall so that when the integrated circuit package using them is placed on a circuit board, the solder columns can accommodate the difference in thermal expansion between the integrated circuit package and the circuit board on which the integrated circuit package is mounted. One problem with solder columns is that they do not withstand compressive forces well. In contrast, solder balls tend to withstand compressive forces much better. Thus, while both solder ball arrays and column grid arrays are used for integrated circuit packages, the instant invention is directed to supporting column grid arrays because column grid arrays have a problem in withstanding

compressive forces that solder ball arrays either do not have or have much less significantly. As such, contrary to the Examiner's position (discussed in more detail with respect to the § 103 rejections), Applicants submit that solder balls and solder columns are not interchangeable for the purposes of this invention.

Lin et al. discloses an integrated circuit package using solder balls to connect it to a circuit board. In contrast, claim 1 requires that the integrated circuit package have a substrate with an array of "solder columns." Further, claim 1 requires "at least one support member affixed to at least one of a side of the substrate and a top surface of the substrate when the integrated circuit package is mounted to the circuit board, the at least one support member extending to the circuit board." The Examiner cites Lin et al.'s edge leads 36 as being support members. However, as discussed in Lin et al., "edge leads 36 are selectively externally attached and electrically coupled to either of or both the upper and lower conductive traces 14, 16 around the periphery of the substrate 12." [Lin et al., col. 5, lines 25 - 28] Lin et al. then goes on to describe edge leads 36 as being commercially available in strip form with standard lead pitches. However, Lin et al. does not disclose or suggest that edge leads 36 provide support for the integrated circuit package, and in particular, support for an integrated circuit package having an array of solder columns. Claim 17 is a method claim having comparable limitations. Applicants submit that claims 1 and 17 are allowable over Lin et al.

Claims 2, 3, 9 and 10 depend directly or indirectly from claim 1 and claims 18 and 20 depend directly or indirectly from claim 17, and are allowable for at least that reason.

Applicants have also amended claim 2 to clarify that the support member is mounted to the integrated circuit package by adhesive after the integrated circuit

package is mounted to the circuit board. As amended, Applicants submit that claim 2 is not anticipated by Lin et al. The Examiner cites Lin et al.'s Fig. 3 and col. 3, lines 55 – 65 as disclosing an integrated circuit package mounted to the circuit board by adhesive. As discussed above, Applicants have amended claim 2 to clarify that it is the support member that is affixed by adhesive to the integrated circuit package after the integrated circuit package is mounted to the circuit board. As amended, Applicants submit that claim 2 is not anticipated by Lin et al.

Claim 3 requires that the integrated circuit package have a lid affixed to the substrate with the lid having an outer perimeter that is smaller than an outer perimeter of the substrate with each support member having a flange extending over the upper surface of the substrate and affixed to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive. The Examiner cites to element 104 of Lin et al. as disclosing a lid of an integrated circuit package having an outer perimeter that is smaller than an outer perimeter of the substrate. However, Lin et al.'s element 104 are solder joints. [Lin et al., col. 8, line 3] Moreover, to the extent that Lin et al.'s edge leads 36 are support members, which Applicants submit they are not as discussed above, they are not attached to either the lid or the upper surface of the substrate by adhesive. Moreover, claim 3 requires that the adhesive accommodate any variation in height of the integrated circuit package. Applicants submit that Lin et al. does not disclose or suggest a support member affixed to at least one of a lid of the integrated circuit package and an upper surface of an upper perimeter of the substrate of the integrated circuit package where the adhesive accommodates any variation in height of the integrated circuit package. The reference to epoxy in col. 3, lines 55 – 65 of Lin et al. is that epoxy can be used to attach the integrated circuit die 20 to substrate 12, but no reference is made to the

adhesive affixing the support member to any part of the integrated circuit package and that the adhesive accommodates any variation in height of the integrated circuit package. Claim 10 contains comparable limitations. Claims 18 and 19 contain comparable limitations directed to the support member being affixed by adhesive that accommodates variations in the height of the integrated circuit package. Applicants submit that claims 3, 10, 18 and 19 are allowable over Lin et al.

REJECTION UNDER 35 U.S.C. § 103

Claims 11, 12 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. Claims 7, 13 – 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of Isaacs et al. This rejection is respectfully traversed for the same reasons discussed above with respect to Lin et al. and with respect to column grid arrays being different for the purposes of this invention from solder ball arrays. Applicants submit that claims 7, 12, 13 – 15 and 21 are thus allowable.


CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will

expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: Dec. 20, 2002

By: 
Roland A. Fuller III
Reg. No. 31,160

HARNES, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

ATTACHMENT FOR SPECIFICATION AMENDMENTS

On the cover page of the application, please amend the title as follows:

METHOD AND APPARATUS FOR SUPPORTING A CIRCUIT
COMPONENT HAVING A SOLDER COLUMN INTERCONNECTS USING AN
EXTERNAL SUPPORT.

ATTACHMENT FOR CLAIM AMENDMENTS

The following is a marked up version of each amended claim in which underlines indicates insertions and strikethroughs indicate deletions.

1. (Amended) A circuit board assembly, comprising:
 - a. a circuit board;
 - b. an integrated circuit package having a substrate with an array of solder columns extending from a bottom surface of the substrate to the circuit board when the integrated circuit package is mounted on the circuit board; and
 - c. at least one support member affixed to at least one of a side of the substrate and a top surface of the substrate when the integrated circuit package is mounted to the circuit board board, the at least one support member extending to the circuit board.

2. (Amended) The ~~apparatus~~ circuit board assembly of claim 1 wherein the support member is affixed to the integrated circuit package by adhesive after the integrated circuit package is mounted to the circuit board ~~by adhesive~~, the adhesive accommodating any variation in height of the integrated circuit package.

3. (Twice Amended) The apparatuscircuit board assembly of claim 2 wherein the integrated circuit package has a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate, each support member having a flange extending over the upper surface of the substrate, the flange of each support member affixed to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

4. (Amended) The apparatuscircuit board assembly of claim 3 wherein the support member comprises a frame surrounding the integrated circuit package.

5. (Twice Amended) The apparatuscircuit board assembly of claim 4 wherein the frame is rectangular and has a support leg and an inwardly extending flange at each corner, each support leg having first and second segments approximately at right angles to each other and each flange having first and second segments at approximately right angles to each other, each flange secured to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

6. (Twice Amended) The apparatuscircuit board assembly of claim 5 wherein the flanges are secured to both the outer perimeter of the package lid and the upper surface of the substrate by adhesive.

7. (Amended) The apparatuscircuit board assembly of claim 3 wherein the integrated circuit package is a column grid array integrated circuit package.

8. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 2 wherein the support member comprises a frame surrounding the integrated circuit package with an inner side of the frame affixed by adhesive to at least one of an outer side of the substrate and an outer perimeter of a lid affixed to the substrate, the adhesive accommodating any variation in height of the integrated circuit package.

9. (Amended) The ~~apparatus~~circuit board assembly of claim 2 wherein the support member comprises a support leg.

10. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 9, wherein the integrated circuit package has a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate, each support leg having a flange extending over an upper surface of the substrate, each flange affixed to at least one of an outer perimeter of the lid and the upper surface of the substrate by adhesive, the adhesive accommodating any variation in height of the integrated circuit package.

11. (Amended) The ~~apparatus~~circuit board assembly of claim 9 wherein the integrated circuit package is rectangular and has a support leg at each corner.

12. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 11, wherein each support leg is affixed to at least one of an outer perimeter of a lid affixed to the substrate and an outer perimeter of the substrate by adhesive, the adhesive accommodating any variation in height of the integrated circuit package.

13. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 10 wherein the integrated circuit package is a column grid array integrated circuit package.

14. (Twice Amended) A circuit board assembly, comprising:

- a. a circuit board;
- b. a column grid array integrated circuit package having a substrate with an array of solder columns extending from a bottom surface of the substrate to the circuit board when the column grid array integrated circuit package is mounted on the circuit board, the column grid array integrated circuit package having a lid affixed to the substrate, the lid having an outer perimeter that is smaller than an outer perimeter of the substrate; and
- c. at least one support member affixed to at least one of an outer perimeter of the lid and a top surface of the substrate by adhesive after the column grid array integrated circuit package has been mounted to the circuit board, the adhesive accommodating any variation in height of the column grid array integrated circuit package, the at least one support member extending to the circuit board.

15. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 14, wherein each support member has a flange extending over the upper surface of the substrate, the flange of each support member affixed to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.

16. (Twice Amended) The ~~apparatus~~circuit board assembly of claim 15 wherein the column grid array integrated circuit package is rectangular and the support member comprises a rectangular frame extending around the substrate, the frame having a support leg and an inwardly extending flange at each corner, each support leg having first and second segments approximately at right angles to each other and each flange having first and second segments at approximately right angles to each other, each flange secured to at least one of the outer perimeter of the lid and the upper surface of the substrate by adhesive.